My Root Finder Applied to a collection of Polynomials

Based on my previous report: A Graphical Twist on the Inverse Quadratic Root Finding Algorithm published on LinkedIn.

https://www.linkedin.com/posts/alfredvachris_a-graphical-twist-for-inverse-quadratic-root-activity-6745791760284344321-2l6A

Look there to see the details about the solution process and the key Subroutine ESTNXT and SETNXT.

The workbook for this report is located here:

https://www.dropbox.com/s/lhswsw9pdggsehd/My_Root_Finding%20Polynomials%20Publish%20V11.xlsm?dl=0

I took a handwritten collection of test polynomials and scanned them. I saved the resulting PDF and used MathPix to OCR the document. This then provided me with a collection of polynomials that I could copy to an Excel sheet.

With a little editing of the original equations, I was able to craft a simple utility that cataloged all the degree of each polynomial and its coefficients.

Sample of the Catalog

Label	Equations	Degree	a	b	c	d	e	f
Test_01	y=6x{4}-4 x{3}-2 x{2}+12 x-3	4	6	-4	-2	12	-3	0
Test_02	y=x{4}+2 x{3}-12 x{2}-2 x+6	4	1	2	-12	-2	6	0
Test_03	y=3 x{5}+20 x{4}-10 x{3}-240 x{2}-250 x+200	5	3	20	-10	-240	-250	200
Test_04	y=x{5}-5 x{4}+5 x{3}+5 x{2}-6 x-1	5	1	-5	5	5	-6	-1
Test_05	y=x{3}+3 x{2}-1x-4	3	1	3	-1	-4	0	0
Test_06	y=x{3}-3 x{2}+3 x-2	3	1	-3	3	-2	0	0
Test_07	y=x{3}-3 x{2}+4 x-3	3	1	-3	4	-3	0	0
Test_08	y=x{3}-3 x{2}+2 x-7	3	1	-3	2	-7	0	0
Test_09	y=x{2}-.73 x-1.17	2	1	-0.73	-1.17	0	0	0
Test_10	y=x{3}-9.3 x{2}-19.3 x+6.6	3	1	-9.3	-19.3	6.6	0	0
Test_11	y=3 x{3}+0x{2}-5 x-7	3	3	0	-5	-7	0	0
Test_12	y=x{3}+0x{2}-2 x-5	3	1	0	-2	-5	0	0

That code is included in the attached workbook, but it is not robust and is not the focus of this report.

So, given the catalog of polynomials, the solution code will process each polynomial.

The first step in the process generates a sweep of values to determine a course and a fine interval that supports a change in sign and hence identifies the existence of a root.

Label	Equation
Test_37	y=x{3}-3 x{2}+2.9 x-.89
Degree	3
A_Coef	1
B_Coef	-3
C_Coef	2.9
D_Coef	-0.89
E_Coef	0
F_Coef	0

X_Course_Test	Y_Course_Test
-1000	-1003002901
-100	-1030290.89
-10	-1329.89
-1	-7.79
0	-0.89
1	0.01
10	728.11
100	970289.11
1000	997002899.1

The fine interval test runs for -1000 to 1000 in various steps.

Resulting in these two test cases for Polynomial 37

Intervals	X_Int_Min	X_Int_Max
1	0	1
2	0.5	1

The solver routine the uses the course internal to find the root and then it does a subsequent run using the fine interval.

All the runs are reported.

Label	Equation	X_Min	X_Max	Zero	Iterations	X_Root	Y_Root
Test_37	y=x{3}-3 x{2}+2.9 x-.89	0.5	1	1.00E-07	6	0.642291273	6.17577E-08

Details are reported for each iteration.

X_1	Y_1	X_2	Y_2	X_3	Y_3	X_4	Y_4
0.5	-0.065	1	0.01	0.75	0.019375	1.047209877	0.005384232
0.5	-0.065	0.75	0.019375	1	0.01	0.652790123	0.002863206
0.5	-0.065	0.652790123	0.002863206	0.75	0.019375	0.638324066	-0.001143048
0.652790123	0.002863206	0.638324066	-0.001143048	0.75	0.019375	0.642088355	-5.75842E-05
0.652790123	0.002863206	0.642088355	-5.75842E-05	0.638324066	-0.001143048	0.642291273	6.17577E-08
0.642088355	-5.75842E-05	0.642291273	6.17577E-08	0.638324066	-0.001143048	0.652790123	0.002863206

During the iterations details are reported by the ESTNXT and SETNXT

Iteration	EstNxt_Note	SetNxt_Note
1	Flip x(1) Flip x(3) xsym= 0.85	Bi_Section new 3
2	Flip x(3) xsym= 0.85	One 2 and 4 Three 2 OK Four 3 OK Four 4 and 3
3	xsym= 0.778799198865808	1 and 4 Three 2 OK Three 2 and 1 Four 3 OK
4	xsym= 0.789965132117027	One 2 and 4 Three 2 OK Four 3 OK Four 4 and 3
5	xsym= 0.775357571121936	1 and 4 Three 2 OK Three 2 and 1 Four 3 OK